

Measuring coastal sediment transport and related shoreline change

Orson P. Smith, PE, Ph.D.



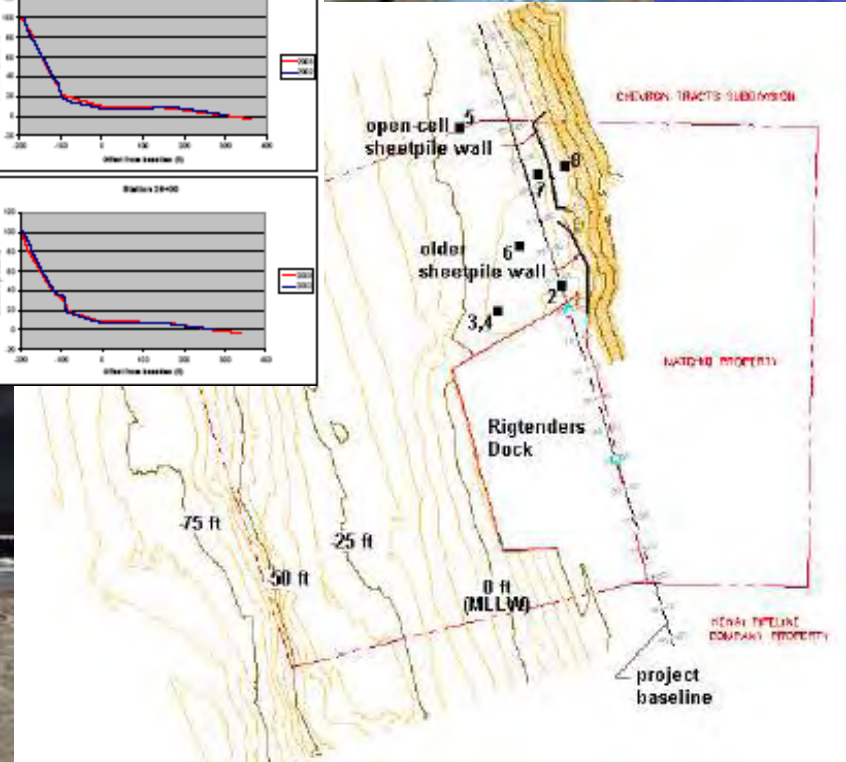
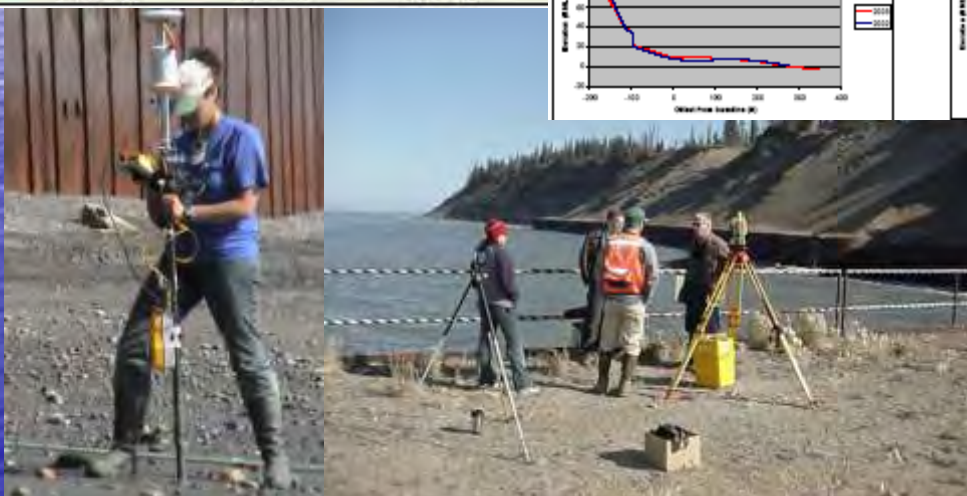
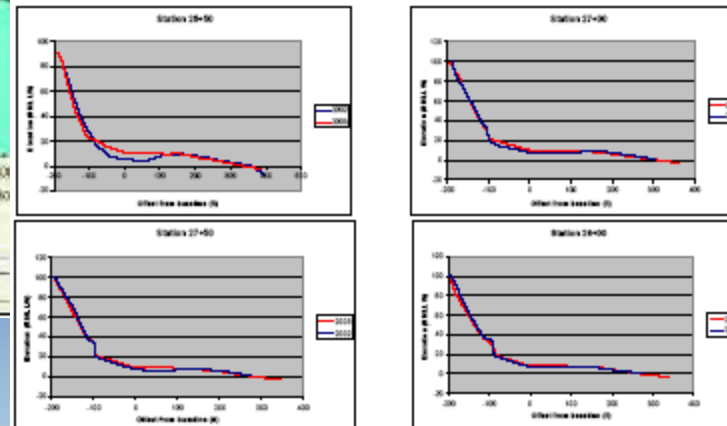
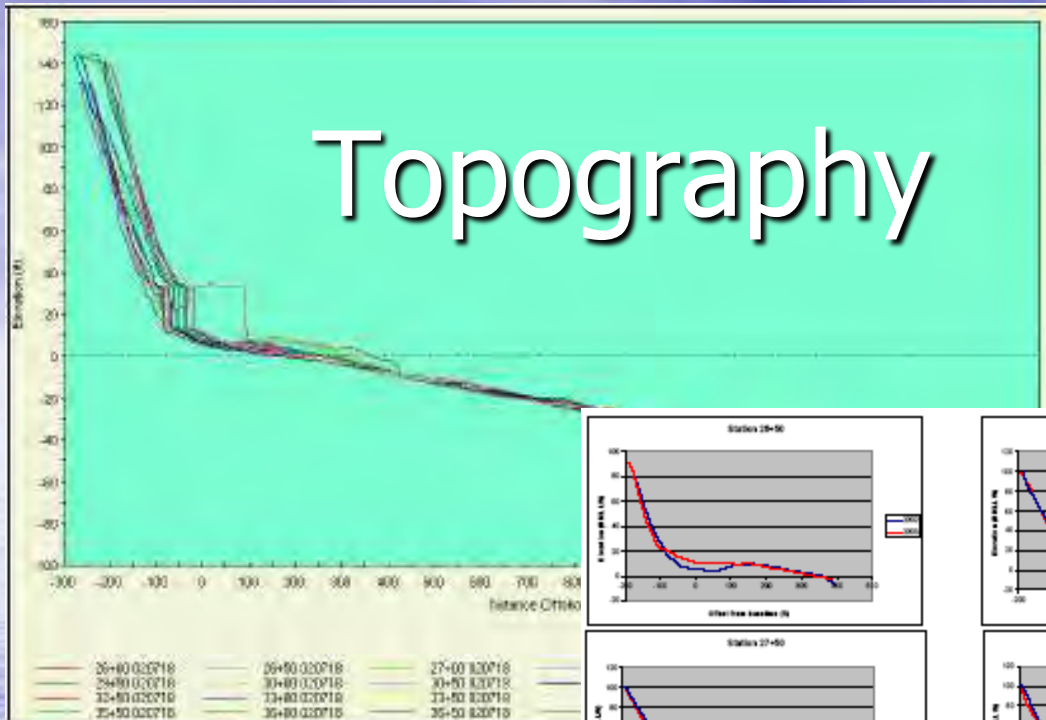
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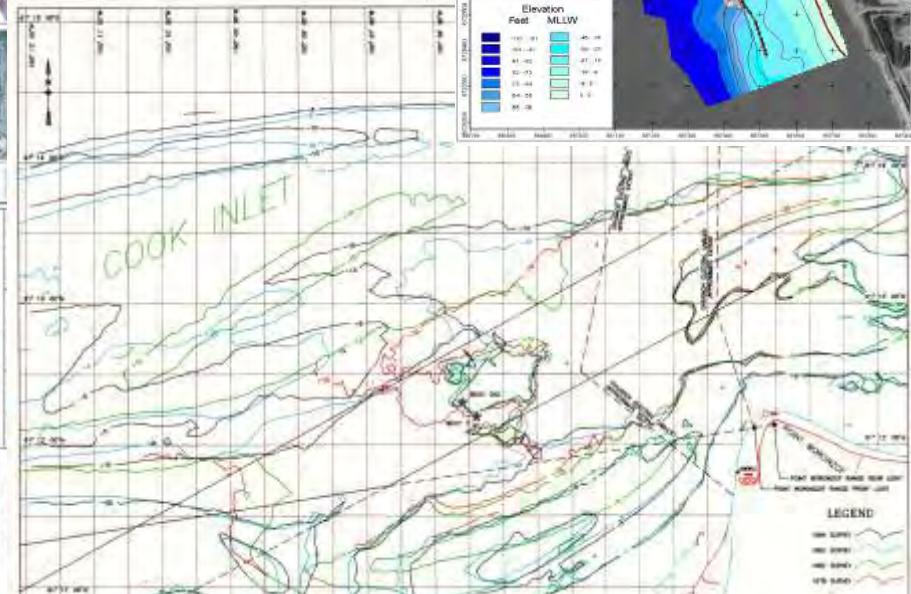
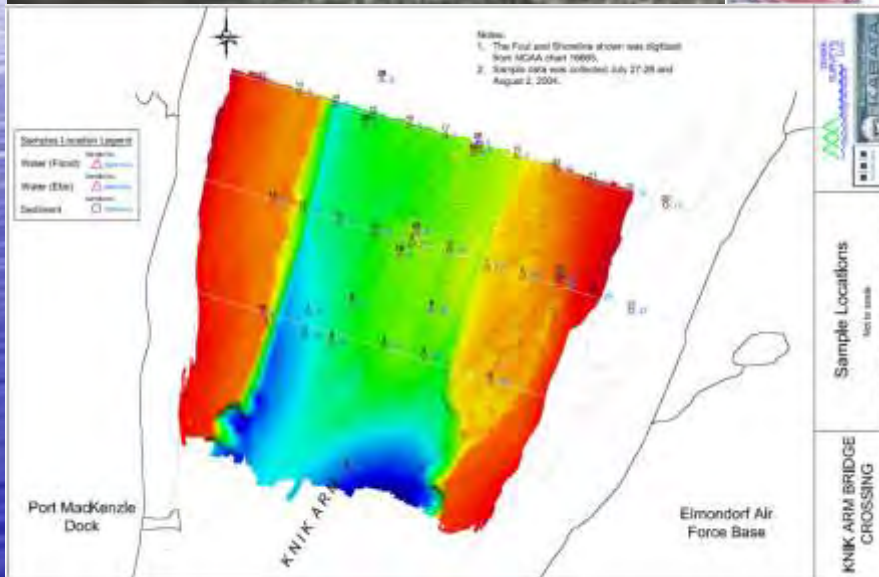
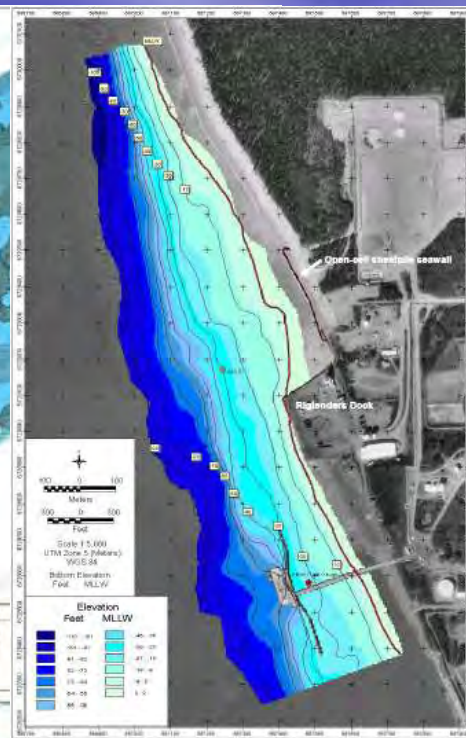
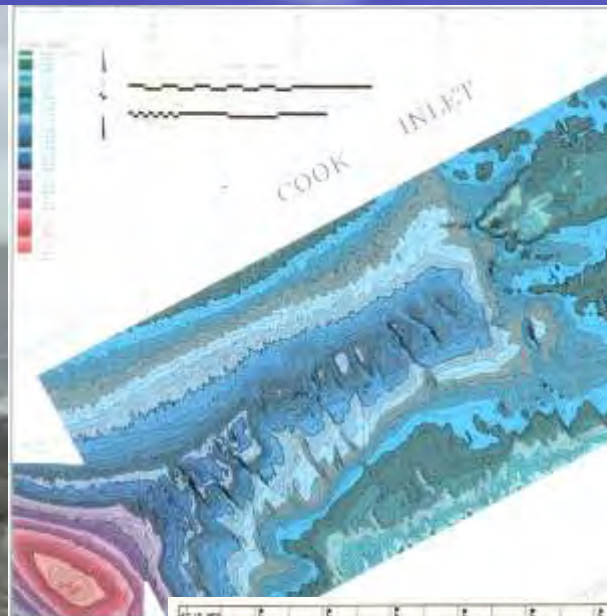
Shoreline Data



Topography



Bathymetry



Wind data for wave hindcasting

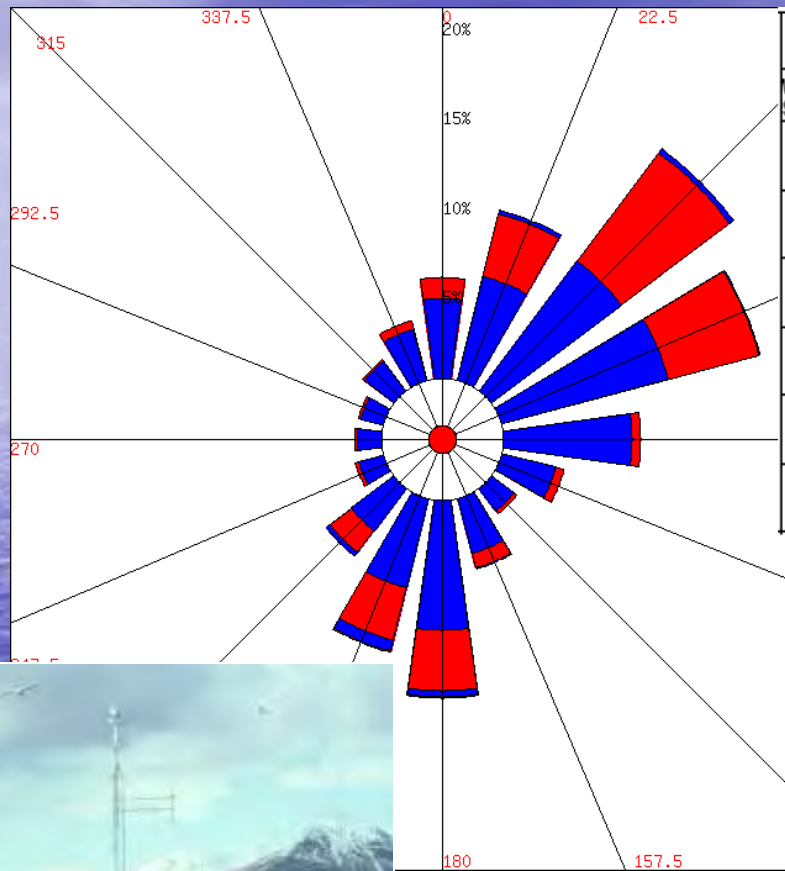
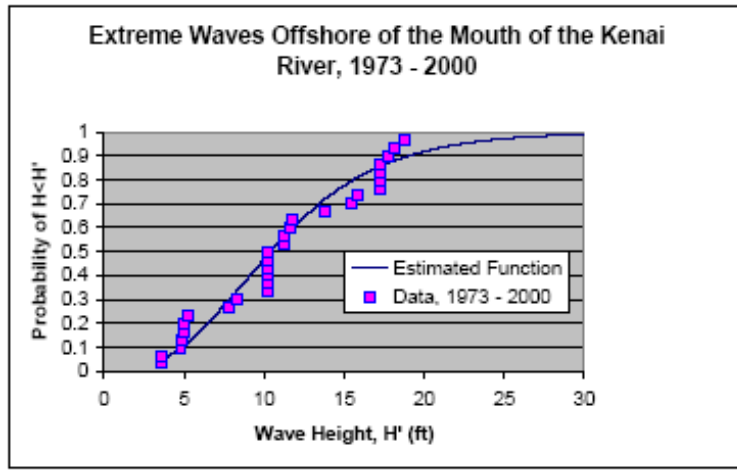
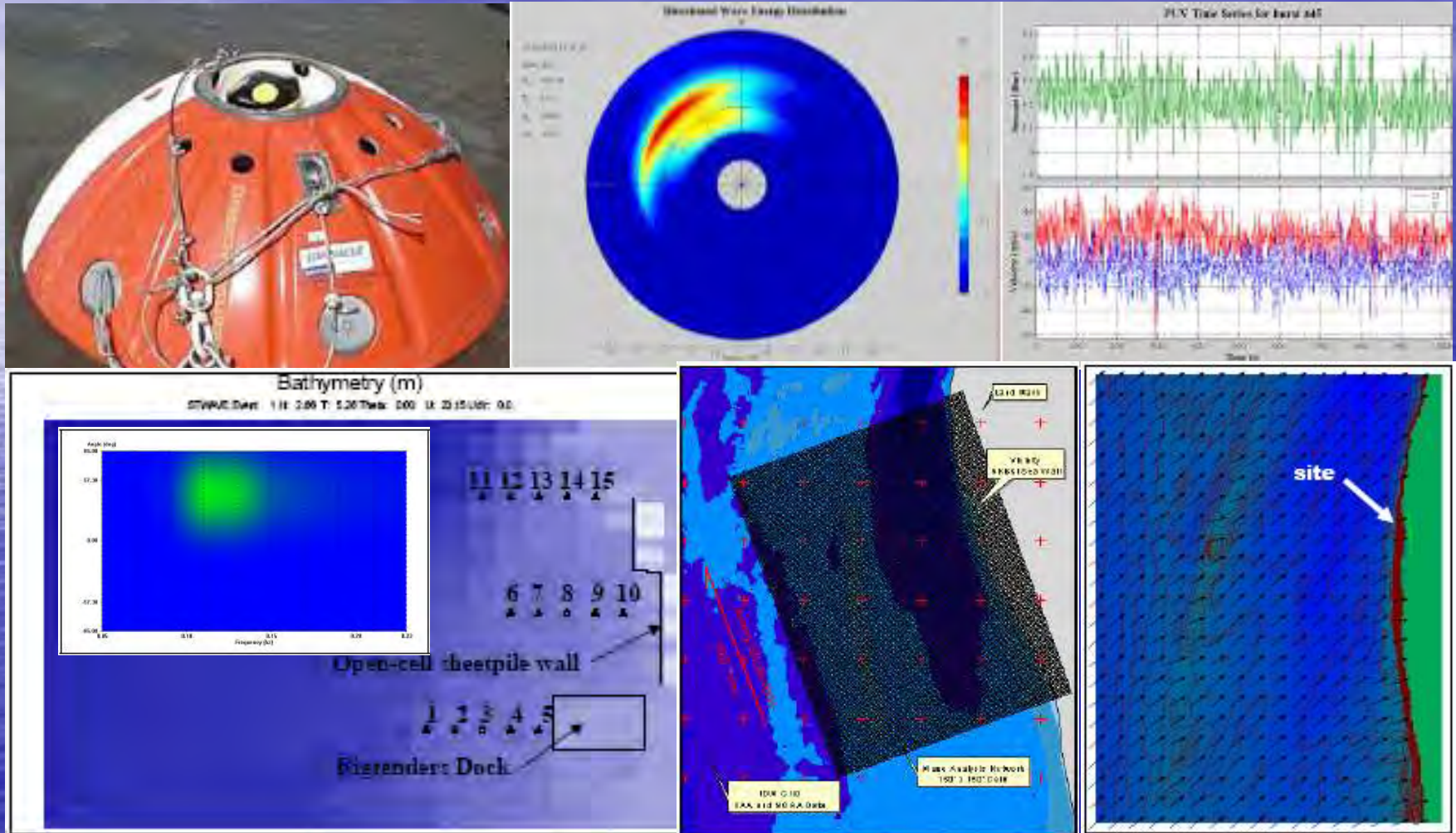


Table 2. Wave height and period for wind speed classes in each onshore sector, calculated using CEDAS – ACES wave prediction software.

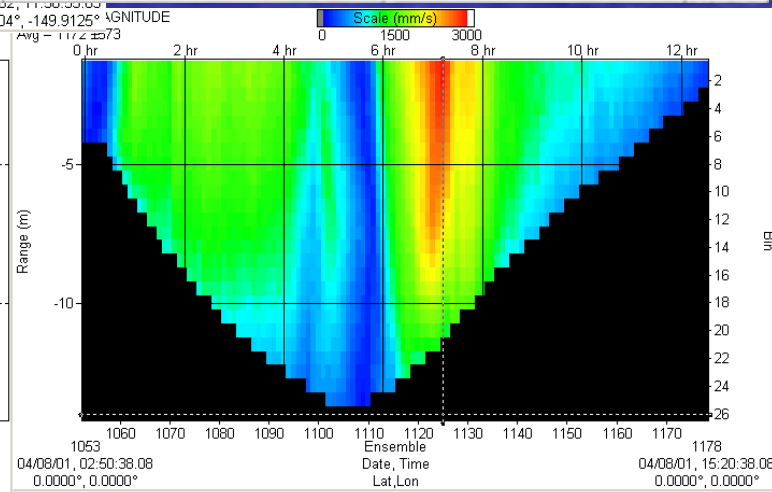
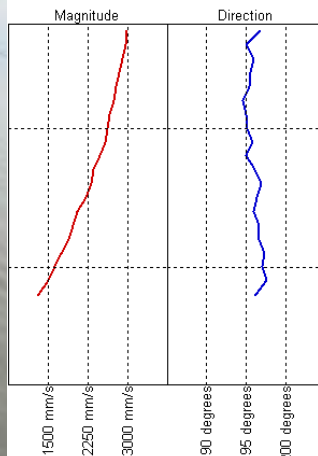
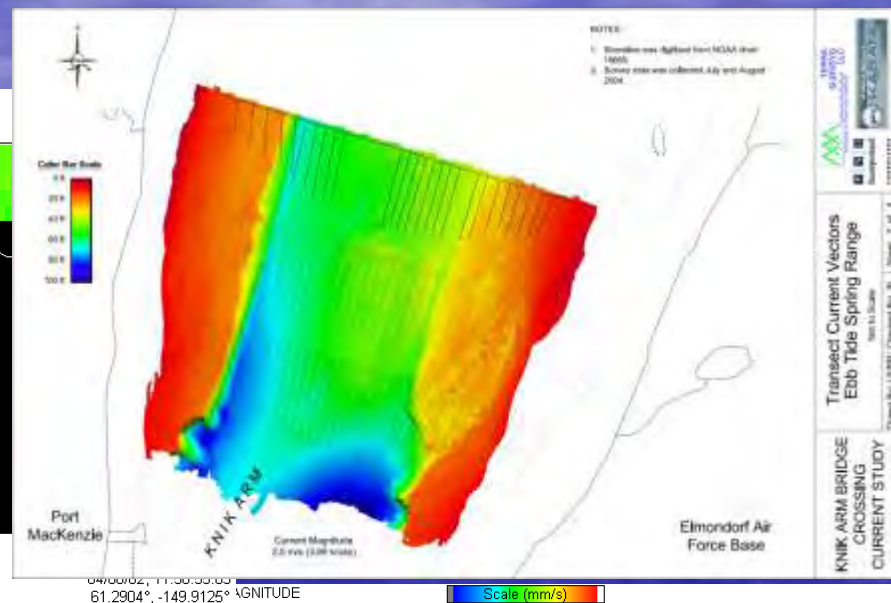
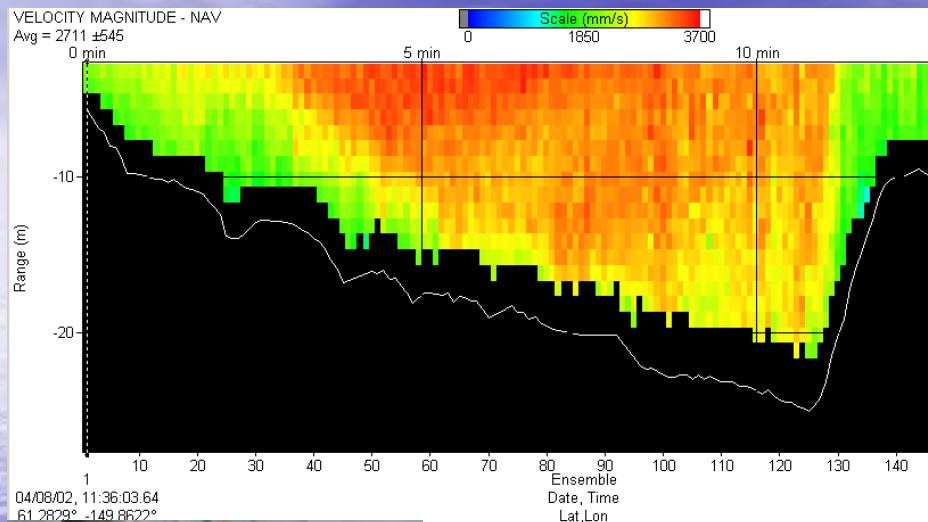
Wind Speed	Speed m/sec	Wave parameter	180 deg	202.5 deg	225 deg	247.5 deg	270 deg	292.5 deg	315 deg
0-9 (5) knots	2.57	H	0.16	0.17	0.17	0.16	0.14	0.13	0.14
10-19 (15) knots	7.72	T	1.56	1.77	1.70	1.55	1.43	1.34	1.36
20-29 (25) knots	12.86	H	0.83	1.53	1.23	0.87	0.68	0.56	0.63
30-39 (35) knots	18.01	T	3.28	4.56	4.01	3.37	2.98	2.72	2.87
40-49 (45) knots	23.15	H	1.43	3.19	2.32	1.64	1.28	1.06	1.18
50-59 (55) knots	28.29	T	4.35	6.43	5.48	4.55	4.01	3.64	3.86
		H	1.98	4.87	3.40			1.62	
		T	5.21	7.90	6.64			4.41	
		H	2.49	6.56	4.45		2.66		
		T	5.94	9.16	7.64		5.60		
		H	2.96	8.25	5.45				
		T	6.58	10.27	8.52				



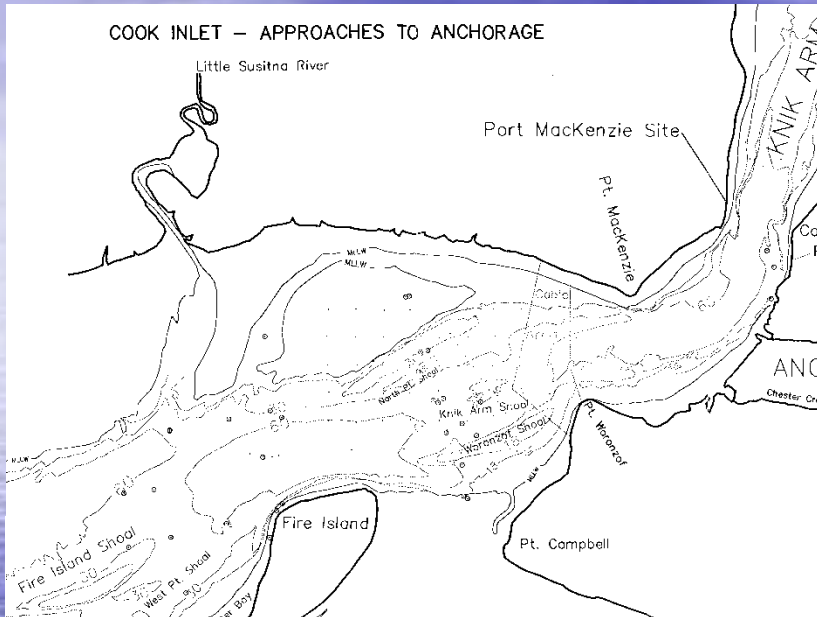
Wave data for modeling



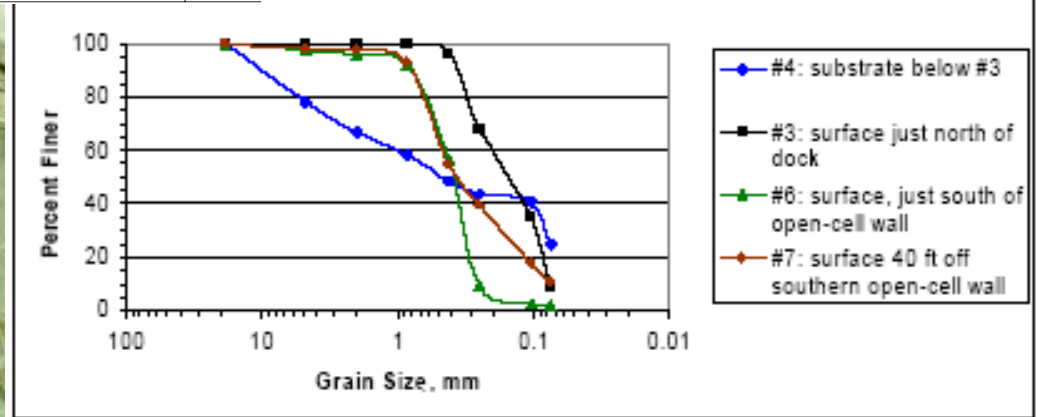
Currents



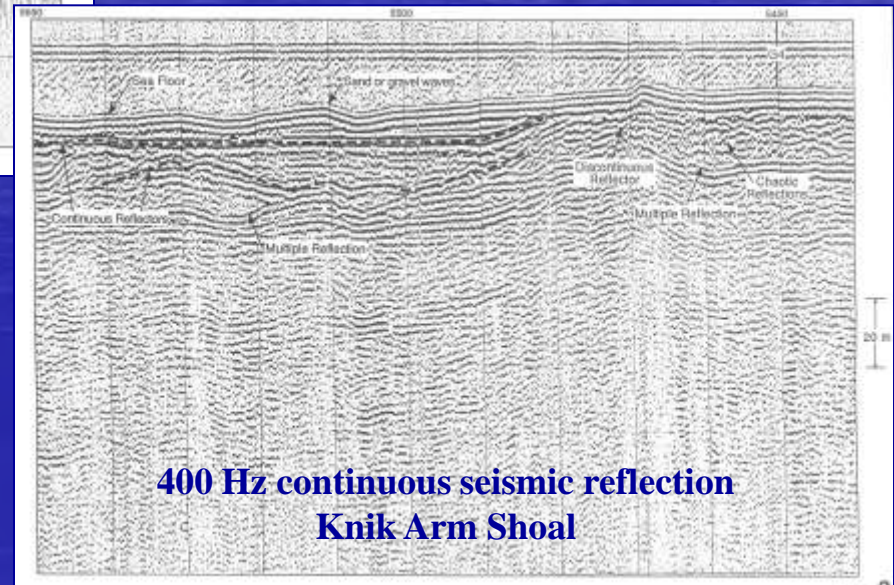
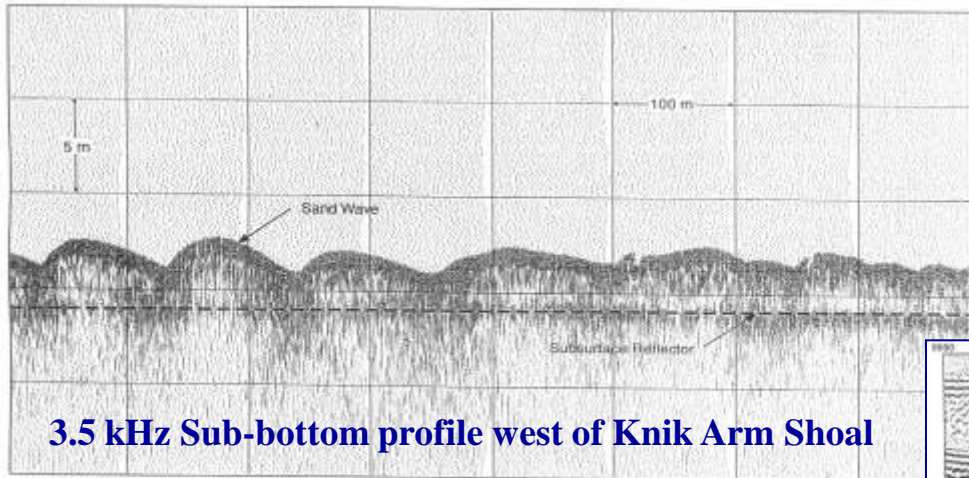
Bed and beach sediment data



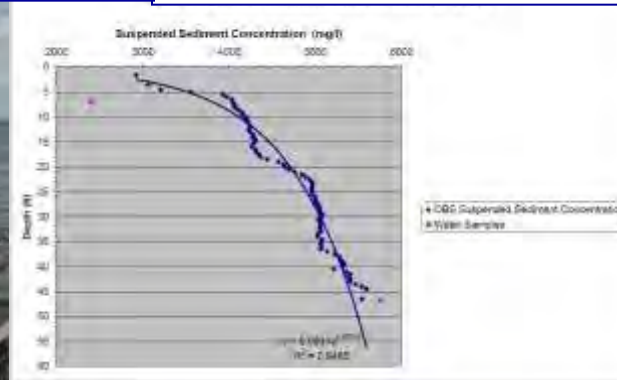
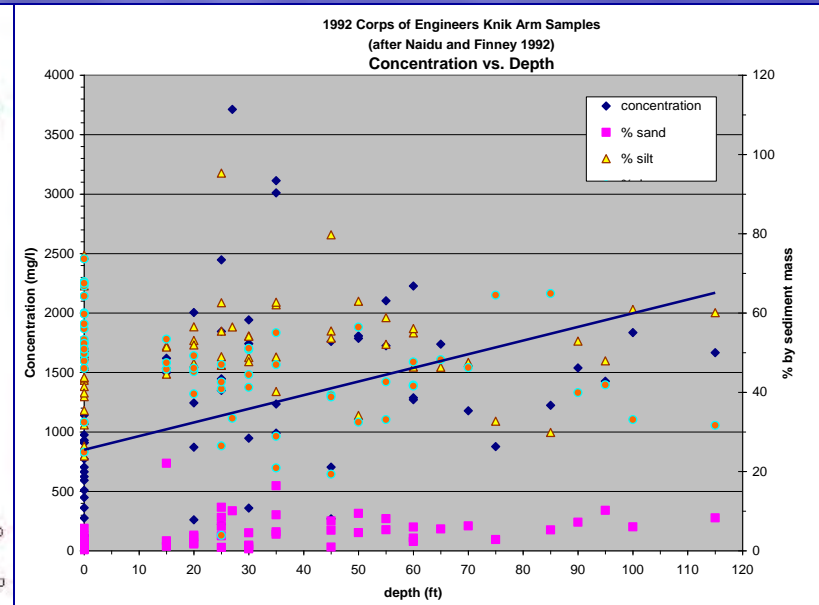
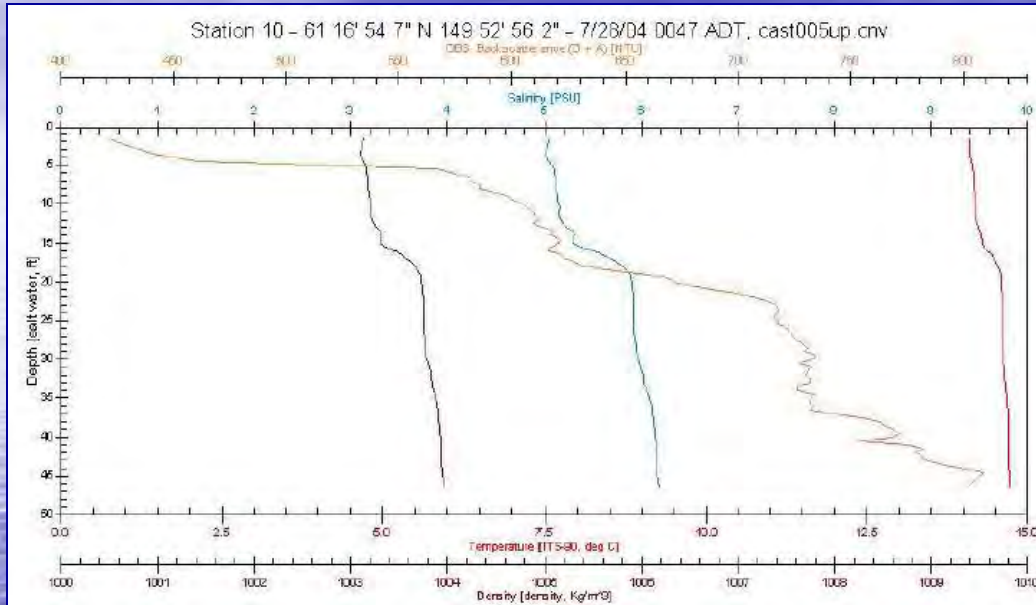
Sample No. 3, 4, 6, & 7



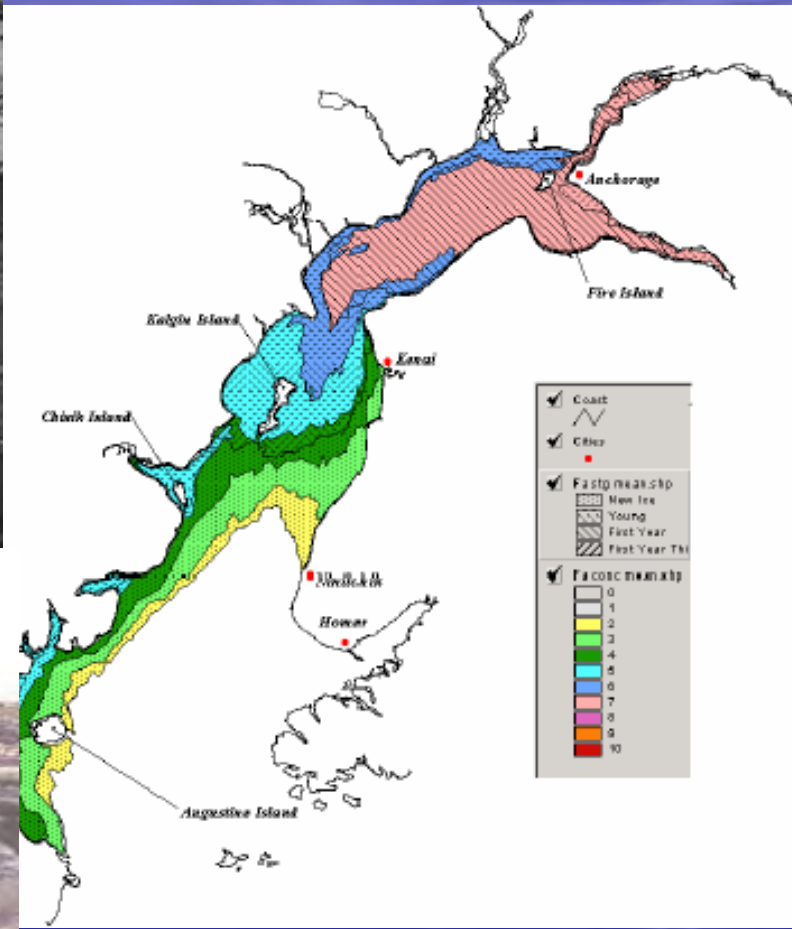
Sub-bottom sediment data



Suspended sediment data



Ice Conditions





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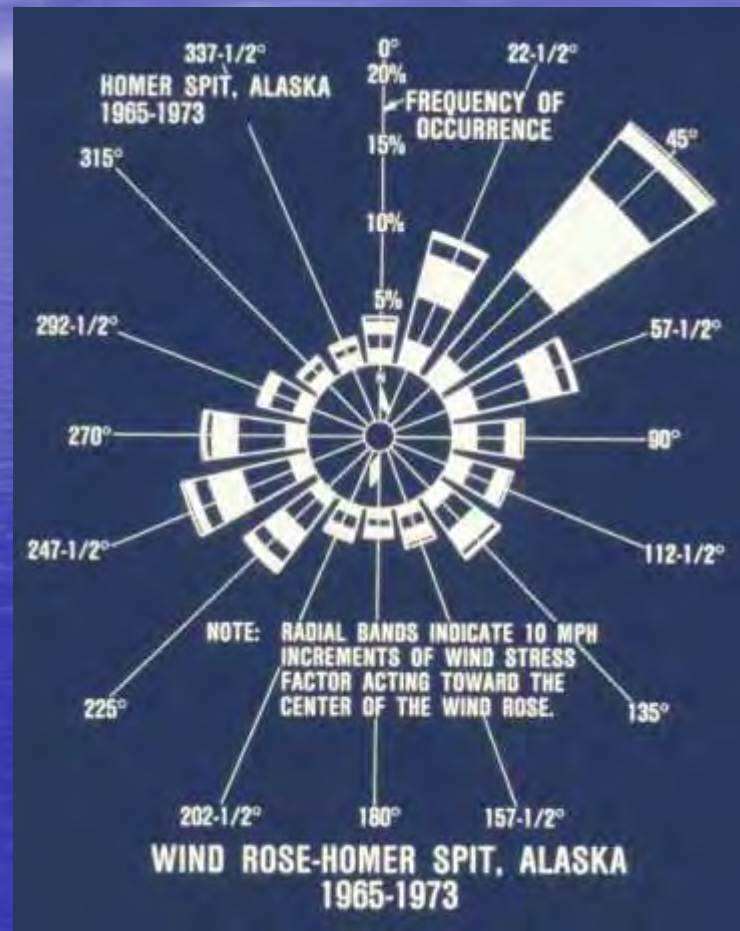
1985

RECONNAISSANCE LEVEL ENGINEERING ANALYSES AT HOMER SPIT, ALASKA

- REVIEW HISTORICAL INFORMATION
- WIND AND WAVE DATA ANALYSIS
- WAVE TRANSFORMATION ANALYSIS
- FIELD DATA COLLECTION
- ANALYSIS OF GEOTECHNICAL DATA
- SEDIMENT TRANSPORT ANALYSIS
- PRELIMINARY DESIGN OF EROSION CONTROL

Smith et al, 1985 (Waterways Experiment Station report)

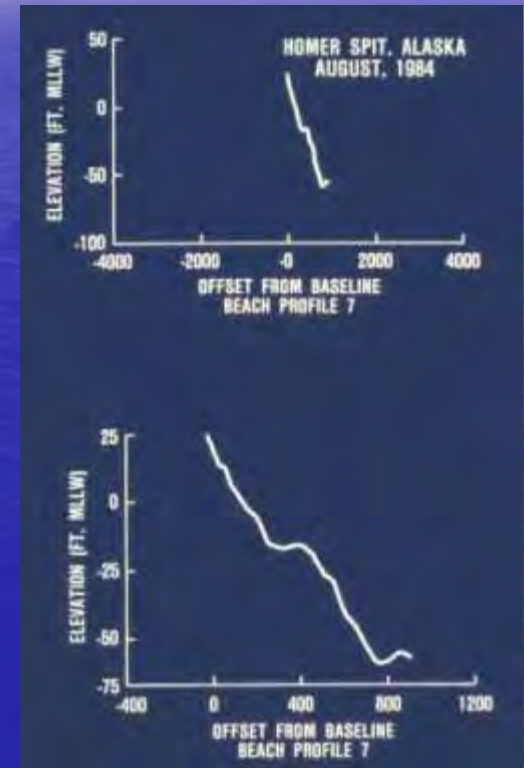
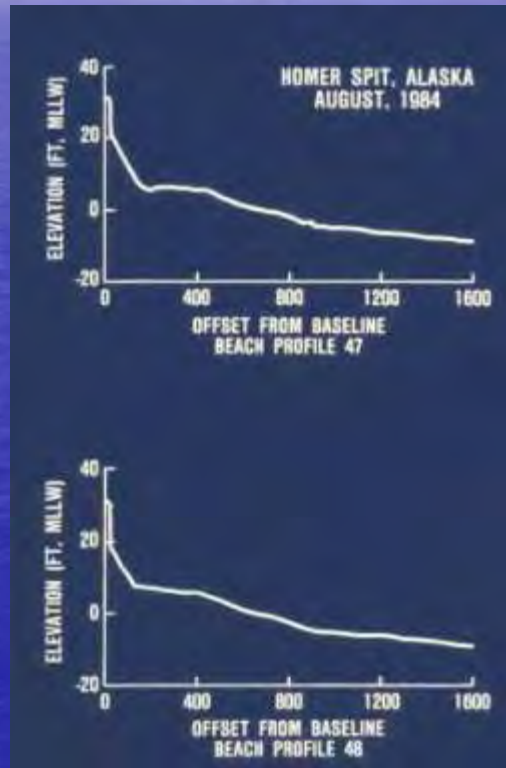
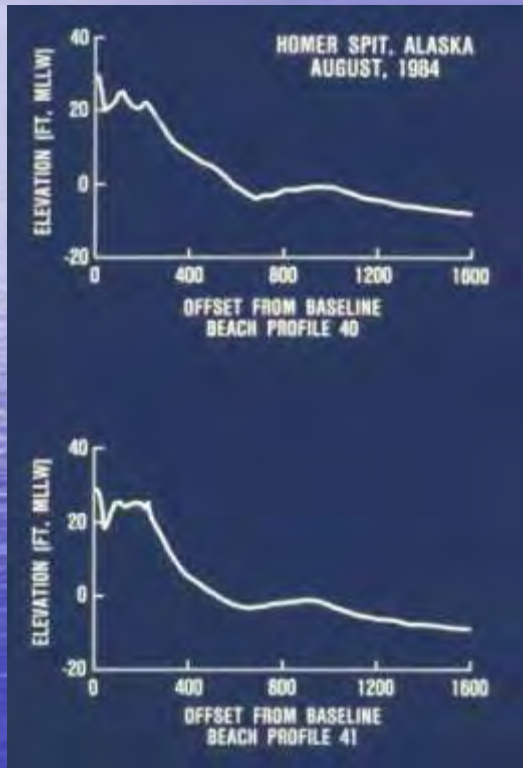
Homer Spit Prevailing Winds



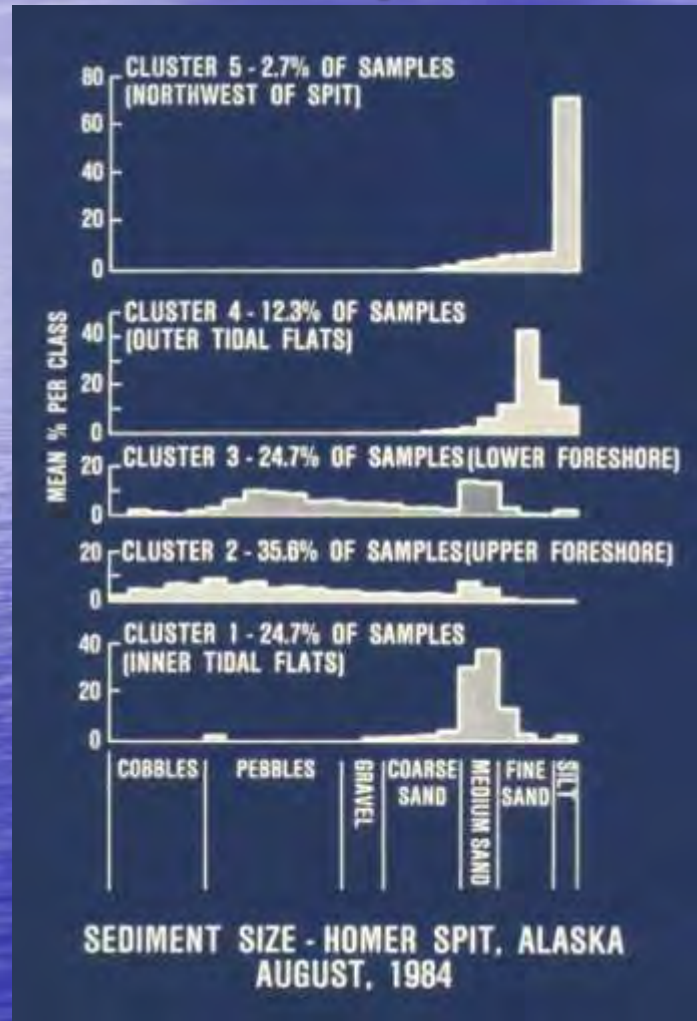
Homer Spit Beach Profiles



1984 Homer Spit Beach Profiles



Homer Spit Beach Material



Wave Transformation Model



Hindcast Longshore Sediment Transport Capacity

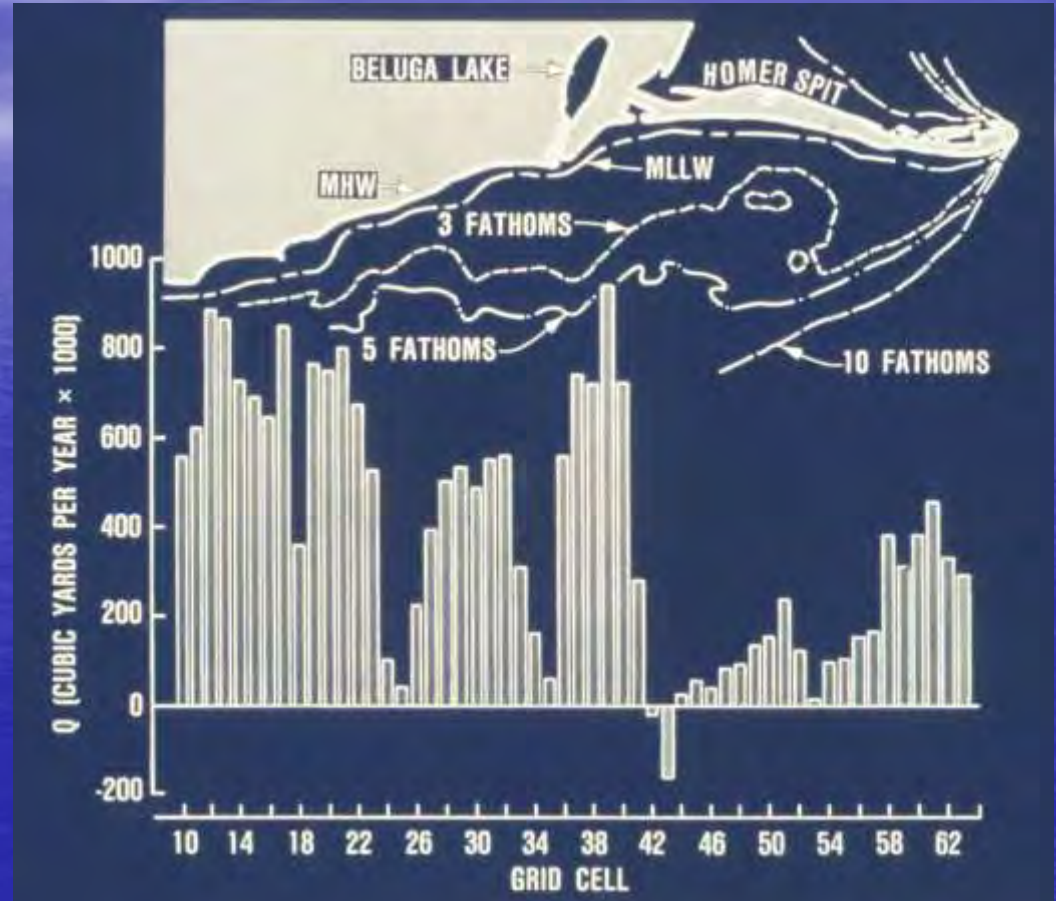
CERC equation

$$Q_t = K \left(\frac{\rho \sqrt{g}}{16 \kappa^{\frac{1}{2}} (\rho_s - \rho) (1 - n)} \right) H_b^{\frac{5}{2}} \sin(2\alpha_b)$$

κ is the breaker index H_b / d_b .

empirical proportionality coefficient K

e.g., $K = 1.4 e^{(-2.5 D_{50})}$



Direct measurements

- Tracers
 - *e.g.*, painted gravel
- Optical and acoustic sensors aimed at the bottom
- Sediment traps
- Beach barrier (temporary beach groin)

Long-term indicators

- Dredging records
 - *e.g.*, Harbor entrance
- Shoreline retreat (or advance)
 - Not practical for hardened shorelines

